NASA Procedural Requirements

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COMPLIANCE IS MANDATORY

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Subject: NASA Program and Project Management Processes and Requirements

Responsible Office: Office of the Chief Engineer

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APPENDIX J: Flight Systems and Ground Support Project Work Breakdown Structure (WBS)

J.1 Introduction

J.1.1 The Project Work Breakdown Structure (WBS) is a key element of project management. The purpose of a WBS is to divide the project into manageable pieces of work to facilitate planning and control of cost, schedule, and technical content.

J.2 Assumptions

J.2.1 The WBS standard elements defined in this appendix are only applicable to the flight systems and ground support product line. There is work in progress to develop standard WBS elements for the basic and applied research, advanced technology development, and institutional product lines. These elements will be incorporated in future revisions of NPR 7120.5.

J.2.2 The following list of assumptions is provided as background information to assist in the development of the project WBS: a. The ONCE (CADRe) database captures major assembly/sub-system (or next lower level) actuals at major milestones (PDR, CDR, etc.). b. Acknowledge that there are both political and technical requirement drivers to a WBS.

J.3 Project Requirements and Business Rules

J.3.1 Purpose: The standardization of WBS elements for the flight systems and ground support (aircraft and space vehicles) product line is being driven by requirements for more effective cost estimating, and consistency of project work packages across the Agency. The standard WBS is intended to apply to projects, not programs. There are no program WBS standard requirements due to the variance in structure of the Mission Directorates and Mission Support Offices.

J.3.2 Requirements: For flight systems and ground support projects:

a. The standard flight systems and ground support project WBS shall be applied to new projects established from June 1, 2005 forward. It is not intended to be applied retroactively to existing projects.
b. The standard flight systems and ground support project WBS shall apply to the entire life cycle of the project, including disposal and decommissioning.
c. The standard flight systems and ground support project WBS shall apply to both crewed and robotic projects.
d. Flight systems and ground support projects shall use the standard Level 1/2 WBS elements (See Section J.5.). Specifically:

1. The Project Name shall be WBS Level 1.
2. The title of each WBS Level 2 element can be modified to facilitate project-unique titles, but the content of each must remain the same. If the linkage of the standard and the project-unique title are not intuitive, the project-unique title shall be cross-referenced to the standard title and provided to the WBS Review Team.
3. The set of standard WBS Level 2 elements do not comprise an exhaustive or exclusive set of WBS elements. Additional WBS elements may be added horizontally (i.e., at Level 2) as long as the content of which does not fit into the content of any existing standard WBS elements.
4. For each standard WBS Level 2 element, the subordinate (children) WBS elements at Level 3 and lower shall be determined by the project.
5. The Level 3 and lower elements can differ from project to project, but shall include only work that rolls up to the standard WBS Dictionary definition of the Level 2 element. (See Section J.6.)
6. If there is no work to fit into a standard WBS element, then an inactive placeholder element (and an inactive placeholder financial code) shall be established.
7. The financial WBS shall align with the technical WBS.
8. The management assigned to each WBS element may differ from project to project.

e. Changes to the standard flight systems and ground support project WBS shall be governed by the WBS Review Team.

f. Other changes can be made to the standard flight systems and ground support project WBS, but must be approved by WBS Review Team. Requested changes shall be made on a waiver form via the Meta Data Manager (to be in operation June 1, 2005) and submitted to the WBS Review Team, whereby a stringent review process occurs ensuring valid rationale is used to support the changes.

J.4 WBS Review Team

J.4.1 The WBS Review Team is chartered to review and approve Project Work Breakdown Structures. The Project Manager documents approval to use non-standard flight systems and ground support WBS Level 2 elements by processing a waiver or deviation through the WBS Review Team.

J.4.2 The WBS Review Team consists of four members:

a. Primary member from the Office of the Chief Engineer

b. Secondary member from the Office of the Chief Engineer

c. Primary member from the Office of the Chief Financial Officer

d. Secondary member from the Office of the Chief Financial Officer

e. Primary members are voting members, and have the authority to approve the project WBS. Secondary members are observers, but can substitute for an absent primary member and then have full voting authority.

J.5 Flight Systems and Ground Support Project WBS Standard Elements

Standard Level 2 WBS elements for the flight systems and ground support product line are shown in Figure J.5-1. The standard WBS template below assumes a typical spacecraft flight development project with relatively minor ground or mission operations elements. For major launch or mission operations ground development activities which are viewed as projects unto themselves, the WBS may be modified. For example, the aero-craft/spacecraft element may be changed to reflect the ground project major deliverable product (such as a facility). The elements such as payload, launch vehicle/services, ground systems, mission operations system may not be applicable and may be deleted.

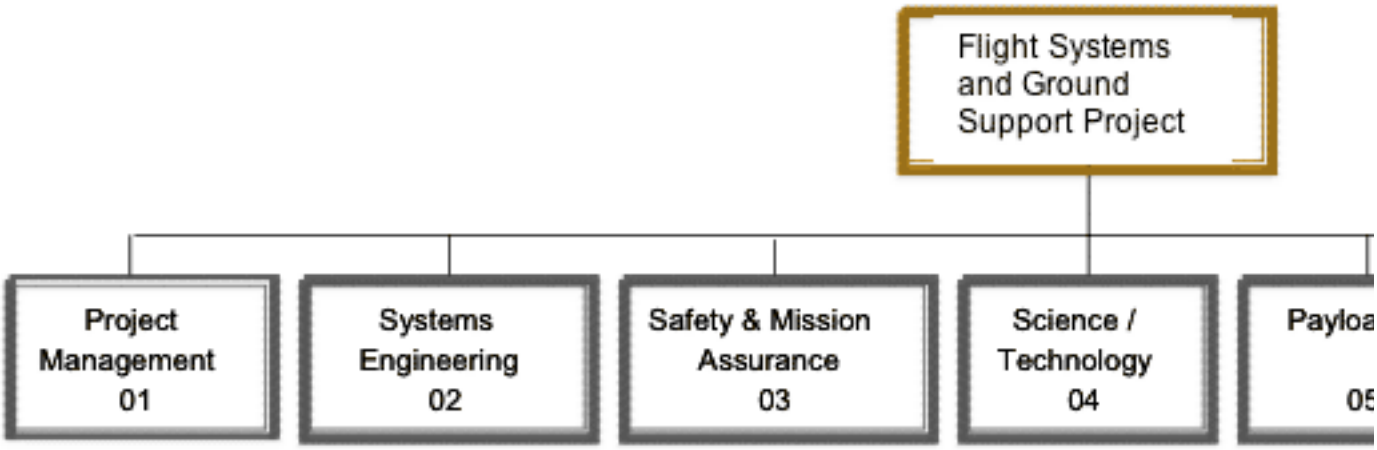

Figure J.5-1

J.6 Flight Systems and Ground Support Project Standard WBS Dictionary

Element 1 - Project Management: The business and administrative planning, organizing, directing, coordinating, controlling, and approval processes used to accomplish overall Project objectives, which are not associated with specific hardware or software elements. This element includes project reviews and documentation (including NEPA), non-project owned facilities, and project reserves. It excludes costs associated with technical planning and management, and costs associated with delivering specific engineering, hardware and software products.

Element 2 - Systems Engineering: The technical and management efforts of directing and controlling an integrated engineering effort for the project. This element includes the efforts to define the project vehicle - ground system, conducting trade studies; the integrated planning and control of the technical program efforts of design engineering, software engineering, specialty engineering, human rating, system architecture development, and integrated test planning, system requirements writing, configuration control, technical oversight, control and monitoring of the technical program, and risk management activities. Documentation Products include mission/system requirements document (MSRD); interface control documents (ICDs); Risk Management Plan and Verification and Validation (V&V) Plan. Excludes any design engineering costs.

Element 3 - Safety and Mission Assurance: The technical and management efforts of directing and controlling the safety and mission assurance elements of the project. This element includes design, development, safety assessment, review, and verification of practices and procedures and mission success criteria intended to assure that the delivered aero-craft/spacecraft, ground systems, mission operations, and payload(s) meet performance requirements and function for their intended lifetimes. This

element excludes mission and product assurance efforts at partners/ subcontractors other than a review/oversight function, and the direct costs of environmental testing. Product assurance efforts should be distributed to each separate product/deliverable WBS element.

Element 4 - Science / Technology: This element includes the managing, directing, and controlling of the science investigation aspects, as well as leading, managing, and performing the technology demonstration elements of the Project. The costs incurred to cover the Principal Investigator, Project Scientist, science team members, and equivalent personnel for technology demonstrations are included. Specific responsibilities include defining the science or demonstration requirements; ensuring the integration of these requirements with the payloads, aero-craft/spacecraft; ground systems, mission operations; providing the algorithms for data processing and analyses; and performing data analysis and archiving. This element excludes hardware and software for on-board science investigative instruments / payloads.

Element 5 - Payload: This element includes the equipment provided for special purposes in addition to the normal equipment (i.e. GSE) integral to the aero-craft or spacecraft. This includes leading, managing, and implementing the hardware and software payloads that perform the scientific experimental and data gathering functions placed on board the aero-craft or spacecraft, as well as the technology demonstration for the mission.

Element 6 - Aircraft(s) / Spacecraft(s): The aircraft or spacecraft that serves as the platform for carrying payload(s), instrument(s), humans, and other mission-oriented equipment in space or air to the mission destination(s) to achieve the mission objectives. The aircraft or spacecraft may be a single aircraft or spacecraft or multiple crafts/modules (i.e. cruise stage, orbiter, lander, or rover modules). Each craft/module of the system includes the following subsystems as appropriate: Crew, Power, Command & Data Handling, Telecommunications, Mechanical, Thermal, Propulsion, Guidance Navigation and Control, Wiring Harness, and Flight Software. This element also includes all design, development, production, assembly, test efforts and associated GSE to deliver the completed system for integration with the launch vehicle and payload. This element does not include integration and test with payloads and other project systems.

Element 7 - Mission Operations System: The management of the development and implementation of personnel, procedures, documentation and training required to conduct mission operations. This element includes tracking, commanding, receiving/processing telemetry, analyses of system status, trajectory analysis, orbit determination, maneuver analysis, target body orbit/ephemeris updates, logistics, and disposal of remaining mission resources at end-of-mission. The same WBS structure is used for Phase E Mission Operation Systems but with inactive elements defined as "not applicable". However, different accounts must be used for Phase E due to NASA cost reporting requirements. This element does not include integration and test with the other project systems.

Element 8 - Launch Vehicle / Services: The management and implementation of activities required to place the aircraft or spacecraft directly into its operational environment, or on a trajectory towards its intended target. This element includes launch vehicle; launch vehicle integration; launch operations; any other associated launch services (frequently includes an upper-stage propulsion system), and associated ground support equipment. This element doesn't include the integration and test with the other project systems.

Element 9 - Ground System(s): The complex of equipment, hardware, software, networks, and mission-unique facilities required to conduct mission operations of the aero-craft or spacecraft systems and payloads. This complex includes the computers, communications, operating systems, and networking equipment needed to interconnect and host the Mission Operations software. This element includes the design, development, implementation, integration, test and the associated support equipment of the ground system, including the hardware and software needed for processing, archiving and distributing telemetry and radiometric data and for commanding the aeronautical or space craft. Also includes the operations, maintenance, and disposal of the project testbeds and project-owned facilities. This element does not include integration and test with the other project systems and conducting mission operations.

Element 10 - Systems Integration and Testing: This element includes the hardware, software, procedures and project-owned facilities required to perform the integration and testing of the project's systems, payloads, aircraft / spacecraft, launch vehicle / services, and mission operations.

Element 11 - Education and Public Outreach: Provide for the education and public outreach (EPO) responsibilities of NASA's missions, projects, and programs in alignment with the Strategic plan for Education (Includes management and coordinated activities, formal education, informal education, public outreach, media support, and web site development).

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